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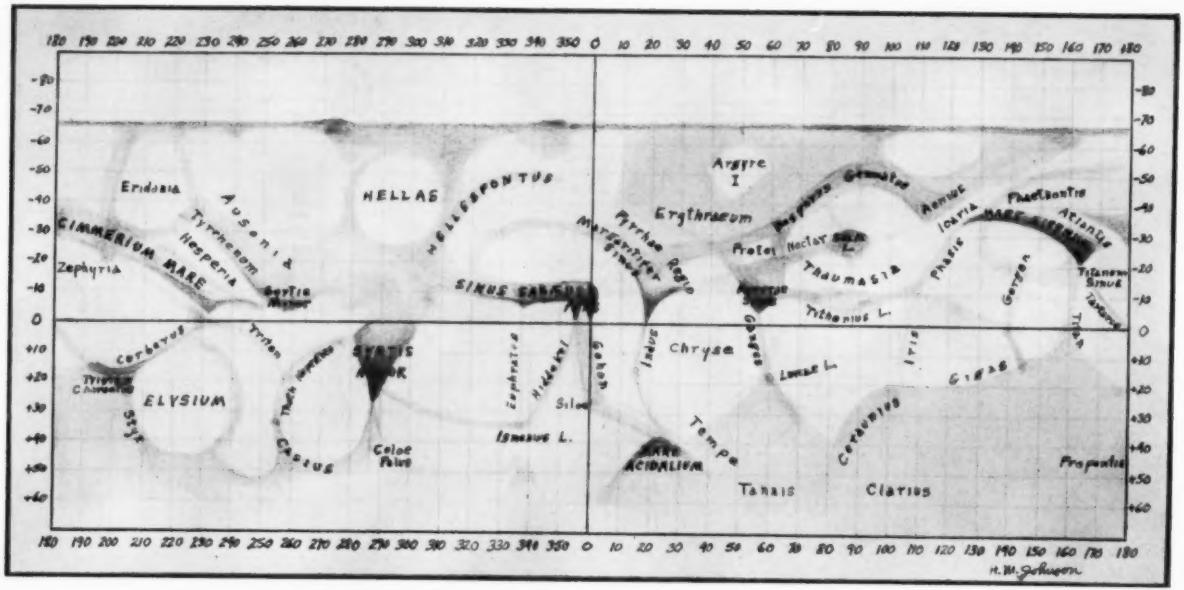
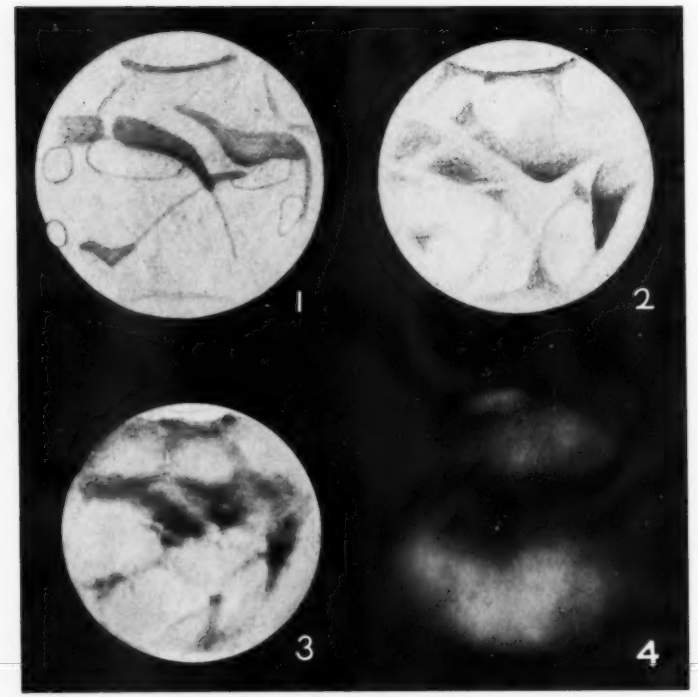
PLATE IX



COMPOSITE MAP OF MARS IN 1939

Journal of the Royal Astronomical Society of Canada, 1941.

PLATE X



DRAWINGS (Figs. 1-3) AND PHOTOGRAPH (Fig. 4) OF THE SAME REGION OF MARS (1939)

Fig. 1.—By W. H. Haas, 8-in. refl., 142 X and 213 X, seeing 3-4, July 21, C.M. 230°, diam. 24″.0.

Fig. 2.—By H. M. Johnson, 8-in. refl., 213 X, seeing 6, July 19, C.M. 248°, diam. 23″.8.

Fig. 3.—By L. J. Wilson, 12-in. refl., 300 X, seeing 7-8, July 21, C.M. 247°, diam. 24″.0.

Fig. 4.—By L. J. Wilson, in orange light, 12-in. refl., July 21, C.M. 245°, diam. 24″.0.

In Figs. 1, 3, 4 the Martian latitude of the centre of the hall was −8°; the longitude of the sun as seen from Mars was 210°. In Fig. 2 these quantities were −9° and 209°, respectively.

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THE 1939-40 APPARITION OF MARS

By HUGH M. JOHNSON and WALTER H. HAAS

(With Plates IX, X)

Introduction

THE approach of Mars in 1939 was a favourable one in spite of the planet's southern declination ($-26°$ at opposition), not only because of the maximum angular diameter of 24″.1 but also because the planet was near enough to be studied to advantage for an unusually long time. At opposition on July 23 (U.T. is the basis of dates and times in this paper) the quantity D⊕, the Martian latitude of the centre of the ball, was $-8°$. Quantity ⊙, the longitude of the sun as seen from Mars and so measured as to be 180° at the vernal equinox of the southern hemisphere, was then 211°.

The observers whose work has been used in this paper and their stations and telescopes are as follows:

1. F. L. FRAZINE at St. Petersburg, Florida. He employed three reflectors of apertures 8, 10, and 12 inches.

2. W. H. HAAS. He used the 9-inch refractor of Case School in East Cleveland, Ohio; 5-, 6-, and 8-inch reflectors in Des Moines, Iowa; two 6-inch reflectors at New Waterford, Ohio; the 10-inch refractor of Mount Union College at Alliance, Ohio; and the 12-inch refractor of Ohio State University at Columbus, Ohio.

3. H. M. JOHNSON at Des Moines, Iowa. He used 5-inch and 8-inch reflectors, chiefly the latter.

4. J. R. SMITH at Smyer, Texas, with an 8-inch reflector.

5. H. B. WEBB at Jamaica, L.I., New York, with two 5-inch refractors.

6. L. J. WILSON at Nashville, Tennessee. He used a 12-inch reflector both visually and photographically.

The Composite 1939 Apparition Map

A map of Mars in 1939 is an almost necessary adjunct to this paper. Such a map is most valuable when it is made without prejudice, is based upon many observations, and employs some fundamental measured positions. We have attempted to meet these criteria in our map, which has been compounded from individual maps by Johnson, Haas, and Wilson, and from positional determinations by the two latter observers. (Plate IX).

We next deal with such positions, using λ to denote Martian longitude and β Martian latitude (the latter is positive north of the equator) of a mark. Between July 8 and August 10, $\odot$ 203° to 222°, Haas obtained the longitudes of 25 marks by noting the times of their transit of the planet's central meridian (C.M.). He made 75 such measures, 1 to 5 for each mark, and corrected for the phase-effect. He further employed his 64 drawings made while the angular diameter exceeded 15″, $\odot$ 180° to 253°, to measure both λ and β for 41 marks. From 5 to 24 drawings were measured for each position; and when the same mark was in both groups, Haas adopted a mean for λ. Between $\odot$ 193° and 233° Wilson measured for λ and β 44 of W. H. Pickering's 100 "stations."[1] We here consider only those 29 of his positions obtained from at least one photograph or two drawings or which can be compared with determinations by Haas. The measures of drawings were based upon suitable trigonometric methods giving most accurate results near the centre of the disk.

TABLE I

POSITIONAL DETERMINATIONS

REGION	$\lambda°$	$\beta°$	OBSERVER	MEASURES
Furca, Nf	0	−2	H *and W*	21d, 4t *and 1p*
Sabaeus, f	4	−5	W	2d
Margaritifer, N	18	−3	H	18d, 2t
Oxia	22	+17	W	1p
Thymiamata, f	22	−1	W	1d, 1p
Protei shading, p	23	−22	H	8d
Horarum, S	24	−26	W	1p
Acidalium, S	24	+35	H	15d
Aromatum, Sp	30	−6	W	3d
Protei shading, f	54	−35	H	8d

TABLE I—*Continued*

REGION	λ°	β°	OBSERVER	MEASURES
Aurorae, N	56	−5	H *and W*	15d, 3t *and 1p*
Juventae, N	63	+8	W	1p
Maeisia	77	−6	W	1p
Tithonius, N bend in	81	−6	H	10d
Solis, c	85	−28	H *and W*	11d, 2t *and 2d*
Thaumasia, S	90	−46	W	1p
Tithonius, f	101	−8	H	9d, 2t
Aonius, N	112	−34	H	14d, 4t
Icaria, N	128	−47	W	2d
Thaumasia, fM	128	−37	W	2d
Sirenum, Np	128	−35	H	9d
Bright area on N shore Sirenum, p	130	−28	H	4d
Dark shading over Amazonis, S	159	0	H	9d
Bright area on N shore Sirenum, f	160	−23	H	7d
Cimmerium, Sp	162	−39	H	12d
Titanum, N	164	−22	H *and W*	17d, 4t *and 1d*
Bright area on N shore Cimmerium, p	182	−21	H	7d
Rift across Cimmerium, c	187	−31	H	5d
Charontis, p	192	+14	H	9d, 1t
Laestrigonum, N	202	−18	W	2d
Charontis, N	205	+25	H	13d, 5t
Rift across Cimmerium, c	209	−27	H	10d
Charontis, f	216	+12	H	11d, 3t
Bright area on N shore Cimmerium, f	224	−1	H	9d
Cimmerium, N	231	−3	H *and W*	17d, 4t *and 2d, 1p*
Tyrrhenum, p	235	−37	H	14d
Thoth, c	252	+33	W	1p
Nuba, S	255	+34	H *and W*	5d, 2t *and 1p*
Syrtis Minor, N	257	−4	H *and W*	15d, 3t *and 1d*
Appendage to Cimmerium, f	257	−3	H	8d
Achates, S	262	−47	W	1p
Nepenthes, c	273	+5	W	1p
Vulturnus, N	273	−26	W	1p
Bright area on p shore Syrtis Major, S	276	+5	H	11d
Syrtis Major and Tyrrhenum junction	277	−6	H	22d
Bright area on p shore Syrtis Major, N	284	+31	H	10d
Hellas, N	286	−37	W	1p
Euxinus, SM	286	−18	W	1p

TABLE I—*Continued*

REGION	λ°	β°	OBSERVER	MEASURES
Syrtis Major, N	288	+26	H *and W*	24d, 5t *and 1d*
Meroe, S	290	+24	W	2p
Bright area on f shore Syrtis Major, N	303	+23	H	7d
Hellespontus, Nc	305	−18	H	19d
Hammonis Cornu	308	−8	H *and W*	23d, 5t *and 1p*
Bright area on f shore Syrtis Major, S	320	−5	H	7d
Hellespontus, Sc	321	−44	H	17d, 3t
Ismenius	337	+34	H *and W*	9d *and 1p*
Sigaeus, N	337	−7	H *and W*	13d, 4t *and 1d*
Broad "canal" from Aryn to Hellespontus, Sc	351	−42	H	15d
Furca, Np	355	−2	H	23d, 3t

[Abbreviations:—First column: S, south; N, north; p, preceding end in longitude; c, centre; f, following end in longitude; M, middle. Fifth column: d, drawing(s); t, transit(s); p, photograph(s).]

Of the 59 marks summarized in Table I, the 11 italicized may be termed *basic positions*. In adopting for them the mean of Wilson's and Haas' independent determinations, we gave the former's smaller number of measures greater weight than the latter's in order to nullify any *systematic* errors in the results of Haas. Our map has been based on these *basic positions* and guided carefully by the remaining positions.

The map itself, on a cylindrical equal-interval projection, has south at the top and east at the left. Haas' map was made from drawings between ⊙ 180° and 253°; those of Wilson and Johnson largely between ⊙ 195° and 235°. The south cap is shown as it was at opposition.* It must be borne in mind that our map is for one apparition and one season (⊙ near 210°) only and naturally does not show so much detail as a general map for many apparitions and all seasons.

In drawing the map each region was represented as it was depicted by a majority of the three individual maps, or if all three disagreed greatly, an attempt was made to portray an average of them. We included none of the finer detail, except for a few oases

*See Figure 5.

measured by Wilson only, unless it was present on at least two of the three maps. Table II lists the canals confirmed in this manner; those seen as the boundaries of shaded areas are italicized.

TABLE II

CANALS CONFIRMED IN 1939

1. Ambrosia	9. Ganges	17. Nasamon	24. Phasis
2. Astaborus	10. Gehon	18. Nectar	25. Scamander
3. Bathys	11. *Gigas*	19. Nepenthes	26. *Styx*
4. Cerberus	12. Gorgon	20. *Nilokeros*	27. Tartarus
5. *Chaos*	13. Hiddekel	21. Nilosyrtis	28. Thoth
6. Erebus	14. Hyblaeus	22. *Nilus*	29. Titan
7. Eunostos	15. Indus	23. *Orcus*	30. Triton
8. Euphrates	16. Iris		

For reference to more complete nomenclature than our map can give, we recommend as excellent general maps those of Flammarion-Antoniadi[2] and of Antoniadi.[3]

We reproduce (Plate X) a set of three drawings (by Wilson, Johnson, and Haas) and a photograph (by Wilson) of the same region on the planet. The reproductions well illustrate the differences in style of sketching detail among these observers. The photograph is one of a great many really excellent examples in different wave-lengths Wilson obtained with his 12-inch reflector.[4]

Description of the Surface

Our nomenclature in this paper is that of the Flammarion-Antoniadi chart of Mars.[2] We shall describe the marks approximately in the order of their increasing longitude, beginning near the zero meridian.

Between Sabaeus and Margaritifer there was a distinct gap or at least a lightness of the maria; this condition may have developed during the period from June to August. Johnson and Wilson saw Gehon as a faint wide band based on the two forks of Aryn and extending northward until intercepted by Oxus from Margaritifer at Siloe Fons. Haas confirmed them to the extent of making Gehon thicker than Indus or Hiddekel but otherwise drew it as a conspicuous canal joining the west fork of Aryn and south tip of Acidalium.

Margaritifer and Aurorae were usually about equally dark, and the rift Pyrrhae Regio may have separated them. In October Aurorae looked extremely dark to Haas; soon after, ⊙ about 300°, he thought the maria in these longitudes much darker than they had been near opposition. The Margaritifer peninsula thinned gradually into the canals Indus and Oxus. On August 11 both Wilson and Frazine readily detected Oxia Palus at the tip of this sinus.

On four dates, with C.M. about 75°, Haas saw a white spot a little north and east of Margaritifer and near the sunset limb. On other occasions he detected two white areas over Chryse and Tempe when these deserts were near the sunset limb. These three marks were not visible when centrally placed. The same observer drew a vertical rift just west of Margaritifer on September 7 and 9; it was gone on September 11. He detected in September and October three other such temporary rifts in this part of the maria, two near Aurorae and one across Bosporus Gemmatus near the south terminus of Ambrosia.

The much foreshortened Mare Acidalium appeared integrated with Niliacus on its south end and with the north polar band on its north end. Haas thought it darker than the southern maria near ⊙ 120°. It was subsequently far lighter, but Johnson and Haas agree that it was darker in early July than in September.

Haas saw the canal Ganges distinctly as such all apparition. Johnson, Wilson, and Frazine observed a large and slightly darkened desert area centering north of Lunae in Tempe; between ⊙ 220° and 240° this region contracted and darkened, forming into a narrow triangular area with its vertex at Aurorae and its base near Tanais-Clarius and containing Ganges.

Johnson drew Mare Erythræum and Mare Australe everywhere much darker than did Haas to whom they were only slightly duller than the northern deserts. Johnson, Wilson, and Haas agree that near July 1 Mare Erythræum either contained rifts or presented a mottled surface. By early August the rifts may have been less plainly marked. A large shading over Protei darkened a little between July and October, according to Haas. This observer on September 16 noted that Pyrrhae Regio was white on the sunrise terminator but lost this hue as it approached the C.M.

Thaumasia was a large roughly circular well-outlined region usually about the same colour and brightness as the northern deserts. It was bounded on its northern edge by Tithonius Lacus, which looked like a broad canal, and on the east and south by Bosporus Gemmatus; both areas were a little lighter than Aurorae. At its west edge lay Phasis, a thick but inconspicuous canal. Of the entire system of fine canals in Thaumasia[5] only Nectar and Ambrosia were seen by all of the three most active observers. Frazine also detected the former, which was probably thicker at its eastern termination than at its western. Haas suspected two delicate canals in the southwest quadrant of Thaumasia; Wilson confirmed these and saw four more. Sinus Aonius was a thin tapering peninsula, the lightest of the southern maria.

In late June Johnson saw Ceraunius as the basis of a counterpart to the dark area centering north of Lunae already described, and between the two ran Antoniadi's Tractus Albus.[3] In May Haas suspected in the deserts north of Thaumasia five canals not subsequently seen; further, the canals Iris and Gorgon and the oasis Ascraeus were probably a little lighter by September than in May.

Mare Sirenum was probably the third darkest of the maria. Wilson and Haas found its north shore to be its darkest part. Near its west end was the intense Sinus Titanum. Perhaps Sirenum was lighter before ☉ 140° and darker after ☉ 275° than between these solar longitudes. Johnson and Haas agree on the presence of Atlantis, which may have darkened between June and October. Wilson and Johnson show Icaria, Phaethontis, and Electris lighter than Mare Australe. Wilson and Haas each depicted the very faint Mare Chronium. Johnson and Haas agree that by ☉ 270° Mare Australe between λ 130° and 210° was darker than it had been earlier in the apparition. On September 3, C.M. 110°, Haas noted no white in Phaethontis on the sunrise terminator; but the next day, C.M. 116°, Phaethontis and probably also parts of Electris and Thyle I were so brilliant and white that they rivalled the south cap. This region was still outstanding on September 7 but not in October and later.

From late July onward Haas saw a large white oval area along the north shore of Sirenum, and Wilson found the deserts brighter between the equator and Sirenum than farther north. This area

was much brighter when near the sunset limb than when central. The three most active observers disagree greatly on the appearance of the northern deserts in these longitudes; the map indicates a feasible composite of their results.

Wilson and Haas found the darkest part of Mare Cimmerium to be its north shore. All observers detected near λ 209° a rift, which Johnson thinks may have darkened between June and October. A striking and unexpected feature of the 1939 apparition was the presence of a small and very dark peninsula near λ 231° at the west end of Cimmerium.* Wilson was the first to detect this mark; he observed that it advanced from β −6° to β +3°.5 between ⊙ 189° and 210°—i.e., at a mean rate of 9 miles a day. A small rift separated it from the rest of Cimmerium. Wilson and Haas saw a dark canal-like streak extending westward from this peninsula toward Syrtis Minor.

All observers perceived Hesperia, which was probably lighter than Mare Australe. Johnson thought that Hesperia darkened between June and October. Eridania was whitish, especially when near either limb.

The fairly large Trivium Charontis was seen regularly. Haas here noted an interesting change. Up to July 23 the east and west portions of Charontis had been of equal darkness. On July 25 the east arm was the lighter, and on the next two dates the difference was still more marked. It is worth mentioning that a drawing by Haas on July 26 does not show the conspicuous canal Tartarus (which joined the east portion and Titanum). By late August this region had resumed its original appearance. Cerberus was among the most marked canals. Johnson observed that Tartarus and some shadings in the deserts just east of it became very marked in October.

Johnson and Wilson drew Elysium as a large and roughly pentagonal region. The canal Triton-Thoth, joining the Cimmerium peninsula and the south tip of Casius, was seen regularly. On June 18 Johnson noted a white spot on each side of the Cimmerium peninsula. From late July onward Haas saw a large white area along the north shore of Cimmerium; it was brightest when near the sunset limb.

*See Figures 2 to 4 in Plate X.

The arm of Mare Tyrrhenum extending south and east from Syrtis Minor was rather light, and a rift severed its southern termination from the rest of it. Syrtis Minor, the darkest part of Tyrrhenum, was rounded and not pointed on its northern shore. The west arm of Tyrrhenum was about the same darkness as Cimmerium. Ausonia was whitish, mostly so on the sunrise limb; but on July 14 it looked duller than the northern deserts.

Syrtis Major was the most conspicuous of the maria, and its northern tip was the darkest mark on Mars (with the occasional exception of the south polar band). All observers agree on a large rift across the southeastern part of Syrtis; and Johnson further noted a smaller rift, Oenotria, in the southwestern portion. Haas suspected that Syrtis narrowed between ☉ 185° and 203°, an interesting observation in view of Antoniadi's assertion that this area narrows as the planet approaches perihelion (☉ 247°).[3] A striking example of Martian atmospheric obscuration (for such it almost certainly must have been) was witnessed by Haas on June 7 and 9: the tropical maria were extremely light from λ 260° to 320°, except for the east and west shores and the north tip of Syrtis Major, but as late as June 5 there had been no noticeable lightening. Johnson and Haas agree that Syrtis darkened considerably about September 20.

When centrally placed, Hellas resembled the northern deserts; but when near the limbs, it was much whiter than they and on a few dates rivalled the south cap. It may have grown progressively whiter between July and November.

In July and August Haas noted a rather large bright area, brightest near the sunrise limb, along the north shore of the maria between λ 240° and 275°. On March 28 and May 1 he saw a white spot in the deserts east of Syrtis Major. Then from July, 1939, to January, 1940, there was a large bright area along the east shore of Syrtis Major; it was markedly white near the limbs and sometimes rivalled the south cap but was only slightly whiter than the adjacent deserts when centrally placed. A similar area along the west shore of Syrtis Major was whitest when near the sunrise limb.

The Wedge of Casius was a light tapering shading extending from the north polar band southward to Nuba, which was pronounced to Wilson. The strongly curved canal Thoth-Nepenthes

joined Nuba and Moeris Lacus. Coloe Palus was seen only near ⊙ 135° and must subsequently have been very faint.

At the junction of Syrtis and Sinus Sabaeus, the second darkest of the maria, Johnson sometimes saw the white indentation Hammonis Cornu. Portus Sigaeus was visible as a small pointed bulge on the northern shore of Sabaeus. The two forks of Aryn were about 5° apart and were easily separated. Aryn was darker than Sabaeus, and Haas considered the east fork the second darkest mark in the maria. Noachis and Deucalionis were lighter than Mare Australe, and Pandorae Fretum was ordinarily seen as a faint streak between them. Johnson and Wilson drew Hellespontus as the west edge of an unusually dark section of Mare Australe between Hellas and Noachis.

The canals and oases in the deserts north of Sabaeus were very differently drawn by the different observers, who agree on the presence of Hiddekel and the faintness of Ismenius but not on much else.

Between ⊙ 280° and 320° the northern deserts were whitened (perhaps by frost during the northern winter), especially near Syrtis Major. Haas, supported by Smith, thinks that the canals were lighter and fewer in 1939 than at the same values of ⊙ in 1937. Although the northern canals might have been expected to be light near ⊙ 200°, the southern and equatorial ones should have been pronounced. The evidence of photographs and the agreements in position among many skilled visual observers can leave little doubt that there actually does exist on Mars a system of streak-like marks, but their exact appearance still remains uncertain. Johnson draws the canals as rather wide and faint streaks but is uncertain as to their true nature. Wilson believes them to be objective and depicts them in widely varying degrees of thickness and sharpness. Haas draws the canals rather narrow and is inclined to think them at least as narrow as he draws them.

In late August Haas observed that large white areas along the north shores of Sirenum and Cimmerium were more readily visible with Eastman Kodak Co. Wratten Filter 25 (red) than with Filter 47 (blue), evidence that they were probably frost rather than clouds. However, at least some of the small white spots in the northern deserts must have been clouds in view of their transiency,

the fact that some of them projected when on the limb, and the evidence of Wilson's photographs. All these white areas were absent near mid-day and were more marked, visually, in the evening than in the morning.

Since the planet was followed from ⊙ 115° to 348°, one would think that many seasonal changes would have been seen to advantage. Still, few prominent seasonal alterations were detected; and in August and September there frequently prevailed at the telescope the impression that various regions looked very much as in July. The experienced Wilson and the authors are strongly inclined to the view that the obscuring action of the Martian atmosphere had much to do with the apparent absence of those seasonal changes often conspicuous at former apparitions. An inspection of the changes we have mentioned reveals that some of them presumably represent "normal seasonal development" but that others are best attributed to local effects in the Martian atmosphere. No darkening of the southern maria was recorded as having occurred until after ⊙ 260°. From ⊙ 200° until at least 245° the northern and equatorial deserts contained numerous white areas of greatly varying sizes.

South Polar Cap

The south cap was observed from ⊙ 115° until slightly past 300° so that the melting and attendant phenomena could be studied to advantage. Figure 5 shows graphically the melting, the cap's angular diameter being plotted against ⊙. The graph is based on measures of 217 drawings by six observers as follows: Haas 102 drawings (including all before ⊙ 170°), Wilson 45, Johnson 35, Frazine 19, Smith 10, Webb 6. In measuring them we encountered three physical sources of error: (1) D⊕, (2) the phase, and (3) a probable eccentricity of the cap with respect to the axis of rotation. Effect (3) averages out with the varying C.M., and effects (1) and (2) are small enough compared to inherent errors in the measures that corrections for them were applied only when urgent.

The present observations support prior ones in indicating the existence of both true surface and atmospheric caps. Thus, between ⊙ 120° and 180° the south cap was probably mostly seen

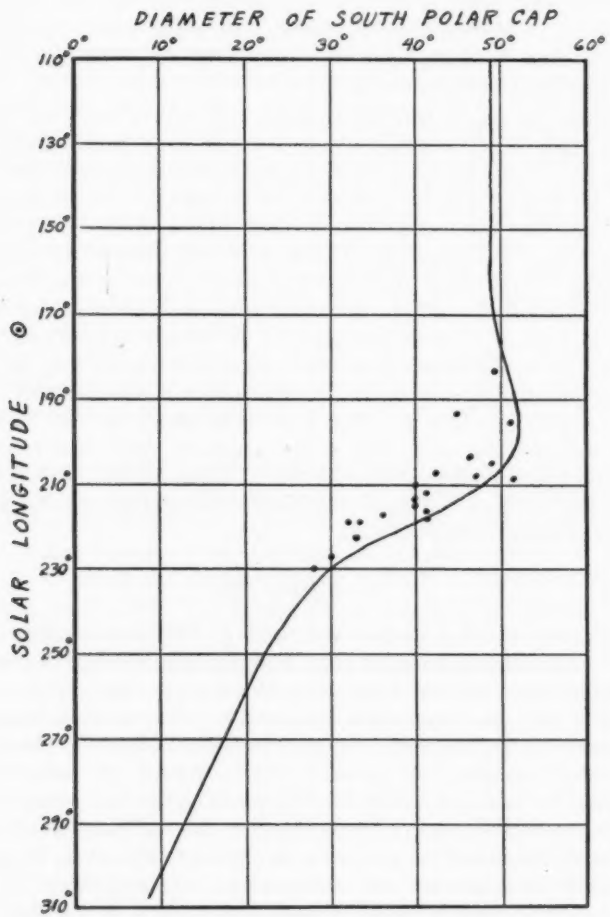

Fig. 5.—Diameter of the South Polar Cap of Mars in 1939-40.

Solid line—Visual mean curve.

Dots—Determinations by photographs in orange light.

as a clouded area varying greatly in angular diameter. The cap was especially dim between λ 170° and 350° near ⊙ 165°. Its constant size before ⊙ 180° on the graph is an arbitrary mean of Haas' widely varying early measures and enables us to avoid explaining the unlikely *enlarging* of the cap at the vernal equinox and the late maximum diameter of 52° at ⊙ 195°. The first observation of a surrounding dark *melt band* at ⊙ 180° suggests that the cap may have already begun to diminish then. Between ⊙ 196° and 208°, and only during this period, delicate rifts paralleling the melt-band were seen in the cap at central meridians ranging from 235° to 82°. Note that these rifts appeared at the beginning of the melt-period. The fastest melt came between ⊙ 210° and 225°. The second group of measures shown on the chart is derived from Wilson's measurements of 20 of his orange-filter photographs, this filter approaching closest to the yellow sensitivity of the normal eye. After ⊙ 270° the south cap was minute as seen on the then small disk of Mars, and after ⊙ 295° it was dimmer than before. At this stage the eye apparently invariably estimated the cap's angular diameter to be several times smaller than it actually was, as measured on drawings which we have no good reason to suppose then out of proportion. Whether or not the cap sometimes was missing in December and whether or not it melted completely after ⊙ 310° in January, 1940, is uncertain; for Mars was then so remote that a cap 5° in diameter would have been difficult to see.

The melt-band surrounding the south cap was usually unbroken and of fairly uniform texture, though apparently darkened at some longitudes by a few far southern maria. However, Haas suspected much fine but unsketchable detail in this band. Near ⊙ 200° the band was usually easily the darkest mark on the globe. With probable minor variations, it subsequently grew fainter and less distinct; by October it was seen only intermittently. No "detached snowfields" were noted in the band region at any period. However, Frazine indicates on three drawings from ⊙ 221° to 223° just inside the band two small delicate bright spots. He estimated their size at between 1 and 2 seconds of arc. Their longitudes, as measured from his drawings, were respectively λ 320° and 20°, while β for each must have been about −70° to −75°. These positions closely correspond to Novissima Thyle and Mons Ar-

genteus. Wilson on August 11, ⊙ 223°, noted two brilliant "humps" (perhaps the same objects) in the south cap and remarks that they were seen in the same places in 1924 at the same season.

The colour and brightness of the polar caps on Mars are apparently intimately related. In 1939 the south cap varied little in tone from a bright and pure white, and such alterations as did occur would probably have escaped an untrained eye. Haas, using three glass colour-filters, found a rather unsystematic variation between "yellow" and "pure white" throughout the apparition, but remarks, "without a filter, no tinge of yellow was ever seen." Johnson, employing no filter, noted that the tone varied between an ordinary "white" and an enhanced "pure white." We consider the degree of purity of the white directly proportional to the cap's brightness. The cap was possibly a purer white after ⊙ 215° than between ⊙ 180° and 215°.

North Polar Cap

The north cap was poorly placed in 1939 because of the negative character of D⊕. With a few exceptions, it was different in appearance and not like the south cap. Near February, 1939, ⊙ 120°, the former was definitely less conspicuous than the latter; from ⊙ 130° to 185° it became even less distinguished, but then it revived for the remainder of the apparition until about November, ⊙ 280°, when the increasing negative value of D⊕ (nearing −20°) rendered it practically indistinguishable on the north limb even though it may have been growing larger, as Haas suspected. All observational data point to the conclusion that the 1939 north cap was purely atmospheric (clouds or mist): (1) Upon Wilson's colour-photographs from June to mid-August the north cap is recorded *only* in blue light. On the other hand, the south cap was about equally striking in all wave-lengths. Wilson's blue-filter photographic work indicates a lack of any detectable north cap between ⊙ 180° and 195°, with growing conspicuousness thereafter. (2) This cap was dull, lacked a definite boundary, and varied in size. Though about the same colour (a slightly varying white) as the south cap, it was almost always much duller than the south cap. The north cap was probably brighter and larger in some longitudes than in

others, being dimmest near λ 300°. Though darker than the southern maria early in 1939, the north polar band was subsequently light and indistinct, and often the north cap was apparently bounded by far northern maria. The angular diameter of this cap varied rapidly, extensively, and unprogressively between 30 and 50 degrees.

Limb and Terminator Projections

These rather rare[6] phenomena consist of temporary cloud formations, either vaporous or dusty. In 1939 projections were observed visually and/or photographically only between ⊙ 199° and 214° and on one date at ⊙ 233°—in all on eleven dates. When on the limb or terminator, they were seen for periods ranging from a few minutes to approximately an hour. Their position in λ was determined by knowledge of the C.M. at maximum conspicuousness and by a correction for the phase, and the position in β was found by direct estimate at the telescope or by measuring drawings. All positions we give apply to the *centres* of these objects. The enhancing effects of irradiation on bright spots may vitiate some of the data.

On July 2 from 6.30 to 7.35 Johnson and Haas held a very small "hump" in the north cap on the terminator; this hump appeared as an integral part of the cap and lay at λ 340°, β+70°. On July 3 at 6.45 Haas saw a second projection on the terminator at λ 320°, β+30°. Wilson observed what may be the same projection again as a small, detached cloud on the terminator at λ 315°, β 0° on July 6 at 7.55. Haas alone observed the following projections: July 9 at 5.50 and July 10 from 6.40 to 6.50. Their mean positions are respectively: λ 258° on the terminator and β+20°, and λ 63° on the limb and β+65°. The latter was in the north cap.

On July 21, 5.42 to 6.04, C.M. 224°, Johnson saw the north cap condensed into two rather large projections on the terminator. They were about 30° apart, and neither lay quite 180° from the centre of the south cap. Wilson's blue-filter photograph of this date at 6.12, C.M. 229°, shows these two "humps" well, and his red and orange-filter photographs with central meridians from 228° to 232° perhaps bear traces of them. At 6.15 on July 21 Haas drew a small, projecting white spot on the terminator at λ 140°,

$\beta+10°$.* Probably the same object was observed on July 24 at 5.40 by Haas and Johnson when they noted the maximum of a bright projecting area on the limb at λ 105°, β 0° to +5°. This projection was seen for 45 minutes and hence had a length of about 400 miles. On July 25 at 5.35 Haas noted the maximum appearance on the limb of a projecting white area at λ 95°, $\beta+5°$. On July 26 Wilson's blue-filter photograph[4] at 5.59 conspicuously exhibits a "brilliant white cloud" on the limb at λ 92°, β 0°. On the same date between 6.30 and 7.30 Haas observed a non-projecting white area on the limb. Evidently he was viewing the following and less conspicuous part of Wilson's object, for the derived longitudes are 100° to 114°. Between 5.10 and 5.23 on July 27 Johnson drew an extended white area on the limb centred near λ 72°, β 0°. He probably was seeing the preceding part of the object. If all these observations relate to the same object, as seems likely, the record shows that, between July 21 and July 27 a whitish cloud originated at about λ 140° and thence moved eastward along the equator for over 2400 miles at a mean rate approaching 17 miles an hour, all the while growing in extent. No trace of it was seen after July 27, and it presumably dissipated. On August 27 at 0.35 Haas noted a projecting bright spot on the terminator at λ 240°, β 0°; at 1.05 another spot at λ 93°, $\beta+5°$ perhaps projected on the limb.

All the projections existed in the northern hemisphere and avoided the temperate zone. Most of them were seen in the sunset region rather than the sunrise region. These objects were somewhat whiter than surrounding limb areas. Pickering in 1922 found[6] that all projections occurred between ☉ 178° and 211° and were in the northern hemisphere (associated with the polar cap). The agreement suggests that we are dealing with seasonal phenomena.

Colours on Mars

Haas carried on regular colour-observations from ☉ 162° to 252° and made 392 colour-estimates. Unfortunately for the analysis of the results, he used three different telescopes, a 9-inch refractor from the end of April to mid-June, an 8-inch reflector from late June to late August, and a 6-inch reflector thence to late September.

*See Figure 1, Plate X.

He employed three glass filters as an aid in estimating colours. Johnson made auxiliary observations from June to November with the 8-inch reflector. All but a few observations were made in a *clear* sky.

One might expect that marked seasonal changes in colour would have been found during the period of observation. In late June, ⊙ 195°, the tropical maria, Australe and Hellespontus, and some northern marks were all bluish-grey or violet-grey, two words for describing the same colour. How long they had been so tinted is uncertain. From ⊙ 160° to 185° Haas had seen browns in the maria; especially had Sabaeus and Aryn appeared markedly brown on May 31. However, this hue may be subjective to this observer. In July, ⊙ 198° to 217°, both Johnson and Haas saw all the maria as bluish grey or violet-grey. In August, ⊙ 217° to 236°, they looked less violet than in July, both observers usually using the same 8-inch telescope as before. At this period Wilson commented that Mare Erythræum was pale blue-grey with no trace of green and that the maria in general possessed a greyish-blue tone. In September, ⊙ 236° to 252°, the writers found the maria nearly grey. The different maria differed little in colour. The south polar band was bluish grey and did not vary distinctly in colour between May 31 and August 19.

Much the most interesting mark on Mars with regard to colour was the dark northern tip of Syrtis Major, a region named Euxinus by Pickering, who sometimes saw there a deep blue colour. In 1937 Haas discerned this hue near ⊙ 148° and 169°; each time it may have changes to grey after a few days. In 1939 he found the same behaviour in June, ⊙ about 184°. No less than 11 observations between July 9 and 22, ⊙ 203° to 211°, reveal that the deep blue colour in that period almost certainly developed in at most four days and persisted for at least three days. However, it was gone a month after it had appeared. These curious changes certainly merit careful investigation.

Concluding Remarks

The height of the atmosphere of Mars has been determined by comparing red and blue images of the planet on photographs. The

latter are found to be the larger and the difference is presumably caused by the planet's atmosphere. Using this attack, Wilson found from his 1939 photographs that the height of the atmosphere is 100 miles, a result in agreement with previous like determinations. Haas attempted an alternative approach in 1939. If solar rays tangent to the surface of Mars at the cusps are not absorbed but illuminate the atmosphere to its top, then one can readily derive formulae by means of which the height of the atmosphere can be computed from micrometric measures of the angular perimeter. The reduction of 16 sets of such measures yielded the absurd height of 0.21 ± 0.23 miles. This negative result may be regarded as additional evidence of Martian clouds or mist over one or both of the cusps.

We found that detail on Mars was often seen to good advantage in a twilight sky even in bad seeing; this result is evidently due to the lessened brilliance of the ball. Haas noted in early 1939 that the south cap grew progressively brighter as the dawn sky brightened, perhaps because scattered blue light from the sky dimmed the yellow disk more than the white cap.

The writers urge anyone interested in actively studying the planet during the favourable 1941 apparition to communicate with either of them on the matter.

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June 24, 1940.

JAMES WEIR OF McGILL UNIVERSITY

By C. A. CHANT

PROFESSOR WEIR died on April 21, 1941. He was born at Miami, Man., on May 8, 1883, a son of the manse. He attended elementary school at Ardoch, North Dakota, and Hay, Huron Co., Ont., and then went to the high school at Petrolia, Ont., to which place his father had moved. Following this he attended the Regina normal school and was a teacher in Saskatchewan from 1902 to 1908. During this time he, his father and his brother George M. homesteaded together near Kenaston, Sask., and he also took extra-murally two years of the arts course of Queen's University, specializing in Greek, Latin, and English. His father taught him the rudiments of Greek at the age of eight. After the homesteading requirements had been completed the property was sold and the two brothers went to McGill. George M. graduated in 1911, and after a distinguished course in engineering James graduated in 1913. He then became assistant to Professor C. H. McLeod, and on the death of the latter in 1917 was appointed Superintendent of the Observatory and Assistant Professor of Surveying. At the time of his death he was Associate Professor of Geodesy and Descriptive Geometry.

Professor Weir was a member of the Engineering Institute of Canada, the Professional Engineers of Quebec, the Royal Astronomical Society of Canada, and a Fellow of the American Geographical Society.

In 1922 he married Miss Isobel Cross who, with a son James Craig, survives him. Three of Professor Weir's brothers hold responsible positions in universities in western Canada: Hon. George M., M.A., D.Paed., is Professor of Education in the University of British Columbia, as well as Provincial Secretary and Minister of Education for British Columbia; John A., B.A., LL.B., is Dean of the Faculty of Law, University of Alberta; Archibald R., B.A., is Registrar of the University of Saskatchewan. Two sisters also survive.

My chief contacts with Professor Weir were through his contributions to this JOURNAL. The first was a short paper giving a

translation by himself from the Greek of an explanation of the method used by Eratosthenes about 200 B.C. in measuring the circumference of the earth. In 1932 on August 31 there was a total eclipse of the sun which was well observed from the province of Quebec and adjoining States. Professor Weir supplied information for observing the eclipse at places in Canada ranging from Halifax to Victoria, B.C. The paper occupied only a few pages, but the computations in it demanded high mathematical ability and much labour. In 1934 appeared an article on "Latitude Determination and Systematic Errors." This was a critical examination of results which had been obtained over a number of years, and useful information was deduced for future observations. The last paper was entitled "Star Identification Aids" and was printed in 1940. It arose through the development of air navigation and supplied information designed for use in the Air Force. It showed Professor Weir's interest in our present needs. All the papers exhibited first-rate mathematical ability and broad scholarship.

For the facts regarding Professor Weir's life I am indebted to Mr. G. J. Dodd, Associate Professor of Civil Engineering, who says: "I enjoyed working with him at the University. I admired his methodical ways, clear thinking, great ability and the thoroughness with which he did everything. He was versatile and modest to a degree."

HER MAJESTY'S MAGNETICAL AND METEOROLOGICAL OBSERVATORY, TORONTO

By A. D. THIESSEN

(Continued from Page 150)

PART VI.—LIEUTENANT C. W. YOUNGHUSBAND, R.A., ACTING DIRECTOR OF HER MAJESTY'S MAGNETICAL OBSERVATORY, TORONTO, 1841-44

(Feb. 17, 1841 to DEC. 5, 1844)

Lieutenant Charles Wright Younghusband, Royal Artillery, was appointed to the position of acting superintendent of the Magnetic Observatory in Toronto upon the recommendation of Lieut. Riddell and Colonel Sabine, while he was still one of the youngest officers in the service. He was at this time only twenty years old. It was at first intended that he should conduct a magnetic survey of the North West Territories in British America, but when Lieut. Riddell was invalided home, he was placed in charge of the Observatory during the absence of Lieut. Lefroy, who, as we have seen, was appointed to succeed Riddell as well as to undertake the survey.

Sabine, as reported in Lefroy's *Diary*,[18] stated on November 25 1840, that

> Lieut. Younghusband . . . has been acting for some months, with the permission of the Master-General of the Ordnance, as a gratuitous assistant to Lieut. Riddell at the Toronto Observatory, with a view of qualifying himself for this undertaking. The zeal he has evidenced, and the very favourable manner in which Lieut. Riddell speaks of him in all respects, show him to be a highly eligible person, and his presence on the spot is an advantage in saving the expense of a passage to Canada."[18]

He was recommended to Colonel Sabine as "a very promising officer . . . I do not see the least objection to the employment of Lieut. Younghusband . . . and I shall be very glad if he is permitted to continue on the service on which he is now employed."[19]

Accordingly Lieut. C. W. Younghusband took charge of Her Majesty's Magnetical Observatory at Toronto and became in effect

[18] LEFROY, J. H. Diary . . . p. vii.

[19] *Op. cit.*, p. viii.

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[19]*Op. cit.*, p. viii.

director of this establishment from the beginning of 1841 to the end of 1844, with the exception of six winter months in 1842-43.

Information about Younghusband is scarce but what has been discovered is interesting. It is known that he was elected Fellow of the Royal Society on June 3, 1852, that he published a paper "On Periodical Laws in the Larger Magnetic Disturbances" in the Philosophical Transactions of the Royal Society,[20] and that he died on October 28, 1900.[21]

We first hear of Younghusband in 1837 when he "was probably the youngest and the smallest officer in the service." He was only sixteen. At that time he attended one of the Levées of King William IV and Queen Adelaide. Lefroy, who attended his first Levée on this occasion, relates the following incident.[22]

> An intimation was conveyed to the garrison in 1837 that the King "liked to see his officers at his Levées." I suppose it was one of those times when he was unpopular, and that they were badly attended. I went to my first Levée on 22nd March, and was presented. His Majesty, however, took my breath away by saying, as I kissed his hand, as I thought in an angry voice, "Who's your father?"
>
> With deplorable want of courtier manners I blurted out, "What?"
>
> "Who's your father?" repeated the King.
>
> "He was a clergyman, your Majesty," said I, and bolted as fast as I could. I imagine that he thought that I was a son of Sergeant Lefroy (afterwards Chief Justice), then M.P. for Dublin University, whom he perhaps knew.
>
> C. W. Younghusband, who was probably the youngest and the smallest officer in the service, was presented at this Levée, and his round chubby face, beaming with boyish spirits, attracted so much notice that the Queen . . . called him into her circle. He was quite unabashable.

Lefroy records another anecdote illustrating the joy of life exhibited by the young officer, at a later period.[23]

> He was staying at a water-cure establishment near Killarney, and the freak took him to disguise himself as an orange girl. He made a very pretty one, and

[20]Phil. trans. of the Royal Society of London, 1853, pp. 165-77.

[21]Charles Wright Younghusband, 1821-1900. Apparently no obituary notice of Younghusband was published by the Royal Society or by *Nature*, nor has one been found anywhere else. As it does not happen very frequently that an army officer is elected Fellow of the Royal Society, it would be interesting to know whether Younghusband was a success.

[22]Lefroy, J. H. Autobiography . . . pp. 55, 61.

[23]*Loc. cit.*

his ready wit soon got all the community round him; then he offered to tell fortunes, and his intimate knowledge of everybody enabled him to make all sorts of humorous hits. The orange girl created the greatest sensation. I think he was not found out.

This is the young officer who, after several months' training under Lieut. Riddell, took charge of the Observatory during the interregnum between Riddell's departure and Lefroy's arrival in October, 1842, and again during Lefroy's absence on the magnetic survey of the North West Territories, 1843-44.

Many of the letters written during Younghusband's administration were routine requests for supplies required at the Observatory, such as would be needed by soldiers living in barracks. These included requests to "the Master Tailor of the Royal Artillery at Toronto to make up the clothing for the detachment under my command,"[24] to the Barrack Master for "articles of Barrack bedding,"[25] and to the Commander of the Royal Artillery for the return, every winter, of "the probable number of great coats required for the detachment Royal Artillery attached to the Magnetic Observatory."[26] A request, on March 4, 1842, for "Stoves, cooking, etc., complete, one" is an indication of the self-sufficient nature of life in a barrack-observatory. There were further the usual requests for "Muster rolls and pay lists" and "Abstracts of subsistence" incidental to routine army adminstration.

As the observatory was at first intended to operate for a three-year period only, the buildings for the observatory and barracks were not constructed in durable fashion, with the result that frequent repairs and occasional "replaistering," whitewashing, and painting, became necessary.[27] Such repairs were stated to have "become necessary in consequence of fair wear and tear . . . and have not been occasioned by neglect or wantonness."[28]

There should also have been regular statements of the transmission of magnetical returns to Woolwich, but during the period of Younghusband's administration there is reference to such a

[24]YOUNGHUSBAND. Toronto, April 27, 1841.
[25]*Idem.* Toronto, June 14, and October 19, 1841.
[26]*Idem.* Toronto, September 6, 1841.
[27]*Idem.* Toronto, Aug. 23, 1841; Mar. 26, 1844.
[28]*Loc. cit.*

return in only one letter.[29] And Lefroy found, on taking over the observatory on October 23, 1842, "that the work had fallen terribly in arrears."[30] This should not be taken to mean, however, that there was any neglect of duty on the part of Younghusband, for, as we shall see from what follows, Lefroy himself was obliged to return to England because of ill health, brought on, he said, by "overwork."[31]

Although there was more work than could be done by the limited staff, the strength of the detachment at the observatory could not be increased.[32] More serious, however, than the amount of work, was the lack of room; and this became the subject of several letters, both from Younghusband and Lefroy. This deficiency was the cause of considerable inconvenience in that it made it necessary that assistants, from time to time appointed for duty in the Observatory, could be chosen from among unmarried men only, and when qualified unmarried men were found unavailable, the problems of barrack discipline were awkwardly complicated. Further, excessive drinking of alcoholic liquor was probably more common in the

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[29]See below: YOUNGHUSBAND. Toronto, May 24, 1842.

[30]LEFROY, J. H. Autobiography . . . p. 63.

[31]"In November, 1850, my health failed so much from overwork and worry that I applied for a Medical Board. . . . I sailed from New York on the 16th in the sailing packet *Yorkshire*, and reached London on the 11th December." LEFROY, Autobiography . . . p. 118.

[32]

Magnetic Observatory
Toronto, March 16, 1844.

Sir, . . .

In reply to your letter of the 12th, enclosing a copy of a letter from Brigade Major Kendall, stating that my request could not be complied with as the strength of the Detachment at the Observatory cannot be increased.

I beg to say that I am not desirous of increasing the strength of my detachment and still hope that Colonel Campbell will not object to a man being attached to me while Gunner Cooper is in Hospital, the loss of one man to the Detachment being a serious inconvenience.

I have, etc.

C. W. Y.

Lieut. Col.
A. Maclachlan
Commanding Royal
Artillery
C.W. Kingston

early nineteenth century, than it is today, and its prevalence among soldiers stationed in a frontier community, therefore, calls for no comment. It did, however, enter into the problems of army discipline and the administration of the Observatory, and further complicated the difficulties arising from cramped living quarters.

The following two letters, one by Lefroy and the other by Younghusband, reveal the situation as it was at this time, at the Observatory and at the Fort.

Magnetic Observatory, Toronto
October 25, 1842

Sir

I beg leave to submit to the consideration of the Commander of the Forces, the necessity of an addition to the Barrack accomodation provided for this establishment. The present buildings were erected in 1840 when the force of the detachment belonging to the Magnetic Observatory was as follows:

1 Officer
3 N.C. Officers
2 Gunners and Drivers including the Officer's Servant.

One N.C. Officer was added in June 1841, and one Officer, one N.C. Officer and one Gunner and Driver (servant) have since joined. In consequence of these additions the present accomodation is insufficient. I have the honour to request that authority may be given to the commanding Royal Engineer to add one room to the N.C. officers' quarters, and one room to the officers' quarters for kitchen and other purposes, also to erect a small out-house to adjoin the building, which is deficient in any convenience of this nature.

I have, etc.

J. H. LEFROY, Lieut.,
R.A.

The Military Secretary
etc.

Toronto, October 10, 1844.

Sir . . .

On enquiry at the Fort into the circumstances mentioned by you respecting Gunner Cole, I found that Gunner Cannon with his family occupied one room, while Gunner Malowney, Jones, and Cole with the family of the latter occupied another.

As it was therefore advisable that either Gunner Malowney or Gunner Cole should be removed; and as Gunner Cole appeared to have had no just cause to be so much dissatisfied with Bombardier Powell's arrangement, I have removed

him with his family into the adjoining room.

I have, etc.

C. W. YOUNGHUSBAND, Lieut., R.A.

Lieut. Col. Maclachlan
Commanding R.A.
Kingston

The case of Non-Commissioned Officer Menzies is further illustration of the nature of this problem. Having been dismissed for drunkenness, he had later to be recalled because no unmarried man with the qualifications and ability of Menzies could be found to replace him. Then—and there appears to have been some trouble about this—shortly after his reinstatement, Menzies confronted the Director with a *fait accompli* in the form of a wife, and a letter of Younghusband, carefully documented with the marriage certificate of Menzies, bears witness to the discomfiture of the Director who has now to regard his assistant as "married *with Leave*."[33]

It is apparent that a good observer should be both steady and unmarried, and that the two qualifications were rarely found together in one man, at least 'twas so in early Toronto.[34]

In the following selection, many routine letters have been omitted; their contents have already been indicated.

Toronto, February 17, 1841.

Sir

Owing to the great improvement in the health of Corporal Johnston,[35], I have desired acting Bombardier George Morris to return to his duty, reporting himself to you.

I have, etc.

C. W. YOUNGHUSBAND,
Lieut., R.A.[36]

Captain Sheppard
Commanding Royal Artillery

[33]Letter by Younghusband, dated Toronto, October 10, 1844; and Marriage Certificate, dated Kingston, January 22, 1844 (!) See also letters below, as follows:

YOUNGHUSBAND. Toronto, July 9, August 3, and August 12, 1842; also May 7, 30, June 3, and Oct. 10, 1844.

LEFROY. Toronto, Dec. 6, 1842.

YOUNGHUSBAND. Toronto, May 30, and June 3, 1844.

[34]See letter below. LEFROY. Toronto, Dec. 11, 1842.

[35]See above. RIDDELL, Toronto, February 5, 1841.

[36]In the following letters this signature will be abbreviated.

Magnetic Observatory
Toronto, August 27, 1841.

Sir

I have the honor to request you will lay the accompanying return of repairs required at the Magnetic Observatory before His Excellency the Commander of the Forces in order that he may be pleased to direct Lieut. Col. Oldfield, Commanding Royal Engineer, to carry same into effect.

I have, etc.

C. W. Y.

The Military Secretary
Head Quarters
Montreal.

Toronto, August 27, 1841

Required in the buildings at the Magnetic Observatory the following repairs, viz., whitewashing for:
Room of observatory, transit room, and passages, (with about one yard of plastering);
Two rooms in superintendent's quarters and passages;
Three barrack rooms of detachment and passages, with about one yard of plastering;
Painting:
Two rooms in superintendent's quarters.

C. W. Y.

The Military Secretary to the
Commander of the Forces.
Headquarters
Montreal

Toronto, November 19, 1841.

Sir

I have the honor to enclose a statement of the manner in which the contingent allowance of £100, granted by the honorable the Board of Ordnance to the Magnetic Observatory Toronto Canada for repairs of instruments, etc., has been expended. The accompanying statement will shew a balance of £2-42-6 in favour of the observatory. I have the honor further to state that authority has been given for the payment of an additional non-commissioned officer, and for the erection of a room for an auxiliary apparatus to be drawn from the contingent, I have therefore to request you will be pleased to lay an application before the proper authorities for an additional grant of £100 as a contingent.

I have, etc.

C. W. Y.

Lieut. Col. E. Sabine
Royal Artillery,
etc.

	£	s	d
From 1st December 1839 to 30th June 1840	13	11	11
1st July 1840 to 30th Sept. 1840	4	2	3.5
1st October 1840 to 31st Mar. 1841	18	8	10
1st April 1841 to 30th June 1841	27	2	9
1st July 1841 to 30th Sept. 1841	26	1	3
	£89	7	0.5
Extra pay to an additional NCO from 19th June to 31st October 1841	8	08	9
	97	15	9.5
	100	00	0
Balance	£2	4	2.5

Magnetic Observatory
Toronto,
January 17, 1842.

Sir

The undermentioned N.C.O.s and gunners having been employed under my command for a period of eleven months, viz.,

Corporal James Johnston, Bombardier James Walker ... No 8 Company 7th B'n
Acting Bombr Thos Menzies ... Detachment 7th B'n
Gunner George Watson ... " 2nd B'n
" Joseph Graham ... No 2 Company 6th B'n

Also for a period of 7 months Acting Bombr Thomas Malines,
No. 4 Company, 5 B'n

I have the honor to report that their conduct has been most exemplary, and that the four N.C.O.s above named continue to shew the utmost attention and ability in the duties entrusted to them. I therefore beg you will draw the especial attention of the Deputy Adjutant General to their general conduct in order that they may be recommended for promotion.

I have the honor further to report that I have turned the wife of Gunner and Driver G. Watson out of the Quarters, for gross misconduct and have also struck the names of herself and family from the ration list.

C. W. Y.

Lt. Col. Sabine, R.A.,
Inspector, Magnetic
Observatories

Magnetic Observatory Toronto
January 18, 1842

Sir

Colonel Campbell having called for an explanation of the complaint of Mrs. Watson, I have the honor to state as follows. My servant Gunner and Driver G. Watson was confined to the hospital on the 17th December. I continued without

a servant for about a fortnight in hopes of his recovery when Assistant-Surgeon Elliott, R.A., in charge of the hospital, recommended my getting another servant, his time of return being very uncertain. I therefore applied to Capt. Storey for a man for the time and on his granting my request was under the necessity of desiring Mrs. Watson to provide herself and family with lodgings until her husband was able to resume his duties. I had put myself to a great deal of inconvenience on her account and felt disposed to do much more had not her conduct on this occasion been so extremely violent and disgraceful to me personally, I had no alternative but to turn her at once from the observatory. Her subsequent conduct has proved that I have not too soon got rid of a very bad woman. I have the honor further to state that I have made a report of her conduct to the "Superintendent of Magnetic Observatories" together with my having struck the names of herself and family from the ration list.

C. W. Y.

Capt. Storey, R.A.,
Comdg. W.D.

Toronto, Province of Canada,
May 18, 1842.

Sir

I have the honour to request you will be pleased to order a medical board to assemble on the case of Gunner and Driver George Watson, 2nd Battalion Royal Artillery, attached to the Magnetic Observatory who has been reported by Assistant-Surgeon Elliot as unfit for any further service.

I have, etc.

C. W. Y.

Col. R. Spark
93rd Highlanders
Commandant

Magnetic Observatory
Toronto, May 24, 1842

Sir

I have the honor to transmit the magnetical returns for the months of January, February, March, and April, 1842, also the remainder of the observations for temperature corrections for the years 1840 and 1841 and also the extraordinary observations from the 1st of January to the 1st August, 1840.

I have, etc.

C. W. Y.

Lieut. Riddell, R.A.[37]
Assistant Superintendent
Magnetic Observatories
Woolwich

[37]Lieut. Riddell was invalided home on Feb. 17, 1841. He was shortly afterwards appointed to this position.

Magnetic Observatory
Toronto, July 9, 1842.

Sir

I have the honor to state that from repeated misconduct on the part of acting Bombardier Thomas Menzies, 7th Battalion, R.A., it is necessary that he should be removed from the detachment at the observatory.

I beg leave, therefore, to request that you will furnish me with a Non-Commissioned Officer in his place, and that you will be pleased to detail acting Bombardier John Maguire for this duty, he being the only man in your company who appears at all likely to qualify himself, for the duties of the observatory.

I have, etc.

C. W. Y.

Captain Storey
Commander, R.A.
Toronto

Toronto, August 3, 1842.

Sir

I have the honor to acknowledge the receipt of Lieut. Colonel Maclachlan's communication desiring that acting Bombardier John McNaught be ordered to replace acting Bombardier Thomas Menzies at the Magnetical Observatory.

I beg leave to request that you will allow acting Bombardier Thomas Menzies to remain for a few days in Toronto to give me an opportunity of judging of the fitness of acting Bombardier John McNaught for the situation, as the duties of the observatory can not be satisfactorily carried on without the proper complement of efficient Non-Commissioned Officers.

C. W. Y.

Lieut. T. B. F. Marriott
Commanding Royal Artillery
Toronto

Toronto, August 12, 1842.

Sir

Acting Bombardier John McNaught having now been at the observatory for a week, during which time I have made myself acquainted with his capabilities, I have the honor to state that I consider him unfit for the duties required of him and that he is not likely, at any early period to qualify himself for the situation. I beg leave to require you will take the earliest opportunity of forwarding the above to Lieut. Col. Maclachlan.

I have, etc.

C. W. Y.

Lieut. Col. T. F. B. Marriott
Commanding Royal Artillery
Toronto

Magnetic Observatory,
Toronto, October 25, 1842

Sir

I beg leave to report to you that no authority has been received by the Ordnance Storekeeper at this Station, to enable him to meet the charges of the Magnetic Establishment under certain items, which have however been authorized by the Board of Ordnance. The following are the authorities under which the Storekeeper is acting.

(1) Board's letter 10 July 1839 S/495, authorizing extra pay for 1 Officer, 2 N.C. Officers, 2 Gunners.
(2) Board's letter 19th August, 1839, A/374, authorizing the extra pay of 1 N.C. Officer additional.
(3) Ditto, same date, A/359, specifying that the extra pay should be drawn from the day of embarkation.
(4) Board's letter 11 March, T/557 directing no further contingent expense to be allowed without the Board's sanction. The balance of the £100 granted for contingent expenses then remaining was £2 4s. 2d.

One additional N.C. Officer joined the establishment 19 June, 1841, and the Officer received instructions to charge his extra pay of 1/3 per diem to the contingent account. He was paid upon that account up to Nov. 1st, 1841, since which no provision has been made for his extra pay.

Extra pay is due to one officer and one N.C. Officer from the date of their embarkation, 14th July, 1842. On appointment to the Magnetic Observatory and survey, the extra pay to the officer up to the date of his embarkation was authorized by Board's letter 18 July, 1842 S/564, that of the N.C. Officer commenced from the date of embarkation.

I have therefore to request that you will be pleased to make application for authority to the Storekeeper

1st To pay the extra pay for one officer and one N.C. Officer from 1st Nov. 1841 (incl.)

2nd To pay the extra pay of one officer and one N.C. Officer from 15th July (incl.) and to continue the same quarterly as an authorized addition to Establishment sanctioned by the Board's Letter 10 July and 19th August, 1839.

3rdly To pay the account of the officer in charge.

For contingent expenses to the amount of £[?] allowed by the Board.

For travelling expenses in prosecution of the Magnetic Survey to the amount of £50 per annum.

I beg to state that a small additional building for comparative experiments has been decided to be necessary for a long period, but that no funds are available to meet the expense of its erection.

I have, etc.

J. H. Lefroy.

Lieut. Col. Sabine
R.A. etc.

Magnetic Observatory
Toronto, November 16, 1842

Sir

A Box containing Instruments and addressed to Lieut. Younghusband, R.A., on the Public Service for this Establishment, was forwarded from England . . . in August or September, 1841, but has never been received . . .

I have, etc.

J. H. LEFROY, etc.

The Deputy Ordnance
Storekeeper
Kingston, Canada West

Note: Copies of the above letter were forwarded at same time to the D.O. Storekeepers at Montreal and Quebec.

J. H. L.

Magnetic Observatory
Toronto, November 24, 1842.

Sir

I have received a communication from Captain Storey informing me that by letter 29th Oct., 1842, from you, it was directed that one only of the men lately joined the Magnetic Observatory is to be allowed the 30s. for winter clothing, the other being considered to have replaced Acting Bombardier Menzies on that duty. I beg to represent that Bombardier Menzies on joining the Company at Kingston took with him his winter clothing, and I also beg to state that the non-commissioned officer lately joined is an addition to the previous force, and not a successor to Bombardier Menzies, whose place remains vacant.

I have, etc.

J. H. LEFROY, etc.

Lieut. Airey, R.A.
Acting Adjutant,
etc.

Magnetic Observatory
Toronto, Dec. 5, 1842

Sir

I have the honor to request that you will lay before the Commander of the Forces an application for authority to the Commissariat to issue rations to the following addition to the number receiving them on this Detachment

One woman
Two children

being the Family of one of the Gunners and lately joined as my servant.

I have, etc.

J. H. LEFROY, etc.

The Military Secretary,
etc.

Magnetic Observatory
Toronto, Dec. 6, 1842

Sir

I beg leave to inform you that Captain Storey has consented to permit a non-commissioned officer of this Detachment to occupy a room in the Barracks if found necessary by a want of accomodation here, and have the honor to request that you will be pleased to appoint a non-commissioned officer or gunner to supply the place of Gunner Menzies, returned to his duty. At the same time I beg to say that if the conduct of Gunner Menzies has been to your satisfaction during the time he has been at his duty, and you be pleased to permit it, I am disposed to give him another trial in consideration of his inexperience in the service, and in the hope that the lesson he has received will make his conduct more satisfactory for the future.

I have, etc.

J. H. LEFROY, etc.

Lieut. Col. Maclachlan
Commanding R.A.
etc. Kingston.

Magnetic Observatory
Toronto, Dec. 11, 1842.

Sir

By letter dated 8th December from Col. Maclachlan, R.A., I am informed that you have received instructions to select a steady Gunner and Driver to be attached as an assistant to this establishment. I have to request that you will be pleased to furnish a *man who in addition to the quality of steadiness, can read, write a good hand, understands simple arithmetic, and is intelligent and able to master the duties he will be called on to perform here. He must be an unmarried man, there being no accomodation for a family.*[38]

I have, etc.

J. H. LEFROY, etc.

Captain Storey, R.A.
etc.
Toronto

A letter by Lefroy, dated December 19, 1842, acknowledges receipt of a favourable answer to his request of December 5 for rations for one woman and two children.

In addition to the number at present authorized I beg in explanation to state that this application was made for the Family of Gunner and Driver George Cooper, my servant, and that he has been in receipt of that allowance previous to his arrival at this station, since his marriage. There were two women with

[38]This is the first statement of the qualifications of an observer in the Toronto Observatory. The italics are mine.—Editor.

the Detachment when it first arrived, who were not included in the proportion authorized to receive allowances in the Royal Artillery on the station as not belonging to the Company. One non-commissioned officer has since married; but as one of the women was about the same time deprived of her allowance for misconduct, no alteration in the number authorized took place. The present being an addition to that number, I made the above application in general terms, in consequence of this Detachment not being borne on the strength of the Royal Artillery at this station.

I have, etc.

J. H. LEFROY, etc.

The Military Secretary,
etc.
Montreal.

Magnetic Observatory,
Toronto, Feb. 6, 1843.

Sir

Gunner and Driver Wm McPhim of your Company, who has been attached to this establishment since Dec. 13, in place of Gunner Menzies, returned to his duty, having shewn himself competent to the duties of an assistant in the observatory, and conducted himself to my satisfaction, I have the honor to request that he may be permanently transferred to this Detachment, and also beg leave to recommend him to you for the rank of acting Non-Commissioned Officer, which will place him on the same footing with the other assistants and enable him to receive the working pay of a non-commissioned officer, as authorized to be drawn for a number which includes him.

I have, etc.

J. H. LEFROY, etc.

Captain Storey
Commanding R.A.
Toronto

After 1842 the Observatory was continued from year to year on orders by the Treasury Office. Occasionally authority to continue was received only after the expiry of the previous order; meanwhile the Director would be obliged to borrow money on the strength of private information that power would later be granted.

Magnetic Observatory
Toronto, Feb. 11, 1843

Sir

In consequence of some delay at the Treasury Office in communicating to the Commissariat at this Station the orders for the continuance of the Magnetic Observatory, that Department has no instructions that it is to be continued beyond the original period of three years, which expired 31st December, 1842.

I have therefore the honor to request that you will lay before the commander of the Forces, the following letters from the Board of Ordnance to the Respective Officers at Toronto, with a request that he will be pleased to give a temporary order to the Commissariat to make the payments therein specified, and to continue all the allowances at present authorized, until instructions arrive from home.

I beg to state that the accompanying instructions to the Respective Officers were applied for by me in October last, and to represent the inconvenience of the delay that will occur should it be deemed requisite to wait for the answer to another application to the Treasury on the same account, especially to myself personally, in consequence of my departure for Hudson's Bay on the 1st of May next on the magnetic survey, with the probability of not returning until the end of 1844. The following amounts are due to the observatory on the 31st January, 1843.

Extra pay	1 officer	£100	10	0	Sterling.
" "	2 N.C.O.'s	15	13	9	
Travelling expenses on account of Magnetic Survey		41	2	3	
Contingent expenses (about)		45	0	0	

J. H. LEFROY, etc.

The Military Secretary, etc.

In a note to a letter written March 9, 1843, Lefroy states that

Allowance for Contingent expenses has been made from time to time by the Board of Ordnance. The following has now been sanctioned as a permanent charge from July 1st, 1842, Letter and estimate, December 2nd, 1842.

Observatory contingent not to exceed per annum: £100.

Magnetic Survey, contingent and travelling expenses not to exceed per annum: £250.

In March Lefroy went to Boston to take personal charge of certain instruments required by him on the survey. On March 13, 1843, Younghusband wrote to The Honourable, The Inspector General, at Kingston, requesting that "Instructions may be given to the Collector of Customs at Queenston for admitting them free of duty."

The status of the Officers in charge of the Colonial Observatories has been defined and illustrated above.[39] That of the Non-Commissioned Officers appears from the letter following:

Magnetic Observatory
Toronto, Sept. 20, 1843.

Sir

I have the honor to state that Acting Bombardier Malines of Captain Lethbridge's Company, doing duty at the Magnetical Observatory, was passed over in his promotion in that Company on a vacancy occurring a short time ago.

[39]Pp. 316-17.

Acting Bombardier Malines bears a very good character, and his conduct has been most satisfactory since joining this detachment. I have ascertained that he was recommended for promotion by the officer in command of his Company, but was superseded in consequence of not being present with it.

I beg leave to call your attention to this matter, as it has hitherto been understood by the non-commissioned officers that their promotion will go on as usual. . . .

I have, etc.

C. W. Y.

Lieut. Col. Sabine
Royal Artillery
Inspector Magnetical
Observatories.

And further

Toronto, October 5, 1843.

Sir

I have the honor to request you will take the necessary steps to investigate the claims to good conduct pay on the part of Bombardier James Walker, 7th Battalion, attached to the Magnetic Observatory, he relinquishing his right to additional pay for length of service.

Bombardier James Walker enlisted October 3rd, 1836, at Woolwich, his name has not appeared in the Defaulter's Book since he joined this detachment (August, 1839).

I have, etc.

C. W. Y.

The next seven letters have to do with requests for clothing and great coats for the men attached to the Observatory. They are omitted.

From one of these, a request for clothing, it appears that the Observatory staff on October 25, 1843, consisted of the following men:

James Johnston, Sergeant;
James Walker, Bombardier;
T. S. Malines, Acting Bombardier;
Wm McPhim, Acting Bombardier;
Joseph Graham, Gunner and Driver;
George Cooper, Gunner and Driver;
T. S. F. Dobbin, Gunner and Driver.

Their heights ranged from 5′ 8″ to just under 6′, and the size of their boots from 7 to 10; from which we might draw the conclusion that the armor of the Crimean Warrior would probably fit World Warrior II.

Magnetical Observatory
Toronto, March 4, 1844

Sir

I have the honor to acknowledge the receipt of your letter of the 29th February permitting me to select a man to attend me from the Detachment under Bombardier Powell and directing that Gunner and Driver Dobbin will join that party in the place of the man I select.

I have the honor to request that in addition I may be permitted to retain Gunner Dobbin in my Detachment in the place of Gunner Cooper in Hospital especially as from the report of the Medical Officer under whose charge Gunner Cooper is, he is not likely to be effective for some time.

I have, etc.

Lieut. Col. Maclachlan
Commanding Royal Artillery.

C. W. Y.

About this time the Observatory required extensive repairs, white washing, painting, and chimney cleaning, and the director under date March 27, 1844, complains that "I do not conceive it was ever intended that the grants of the Magnetical Observatory for contingent expenses should be applied to such purposes as sweeping the chimneys of the Quarters of the Detachment."

The next letter, April 10, 1844, protests against the reduction of the light and fuel ration for the Observatory, and requests that food rations be issued "at intervals of one month, in consequence of the distance of the Commissariat Offices from the Observatory."

Toronto, May 7, 1844.

Sir

I have the honor to request that I may be furnished with two intelligent and trustworthy Non-Commissioned Officers to replace Acting Bombardiers Thomas Malines and Wm McPhim at the observatory, as from the continued unsteadiness of these men I cannot place any degree of confidence in them.

I should be obliged by your allowing Gunner and Driver Thomas Menzies to be one of the men sent, if you can speak of his character, and he is willing to undertake the duty.

I have, etc.

C. W. Y.

Lieut. Col.
Maclachlan
Commanding R.A.
Canada West

In response to this request Lieut. Col. Maclachlan sent Acting Bombardier William Grace and Gunner and Driver B. Cannon to replace the men dismissed for "unsteadiness".

"Cannon being a married man with a family for which I have no accomodation . . . is objectionable as one of the assistants in the observatory," was Younghusband's reply, on May 25, 1844. He added: "that the nature of the duty rendering the men liable to be called up at any time of the night, it is perfectly necessary that all of them should sleep in Barracks."

Menzies, who had been dismissed on July 9, 1842, now appears to become more and more desirable as an assistant:

Magnetical Observatory
Toronto, May 30, 1844.

Sir

As I am informed by your letter of the 28th instant that you have no objection to sending Gunner and Driver Thomas Menzies to Toronto, I beg to request that this may be done.

I am induced to make this request as Gunner Menzies has had experience in the duty of the observatory, and a great deal of time must be spent before a man entirely unaccustomed to office work could be available in the ordinary routine; also, although Gunner Cannon may be found fully eligible for the duty required of him, his living out of Barracks, at however short a distance, would be very inconvenient.

I have, etc.

C. W. Y.

Lieut. Col.
Maclachlan, etc.

Accordingly, on June 3, 1844, Younghusband acknowledged "the arrival at the observatory of Gunner and Driver Thomas Menzies. Acting Bombardier McPhim left Toronto in the steamer this day," and on July 13th he forwarded the winter clothing of Malines and McPhim to Kingston.

Shortly after his arrival in Toronto Menzies embarrassed Younghusband with the following:

Kingston, Canada
January 22, 1844

I HEREBY CERTIFY THAT THE RELIGIOUS CEREMONY OF MATRIMONY WAS DULY SOLEMNIZED BETWEEN THOMAS MENZIES OF THE TOWN OF KINGSTON AND ANN ALLEN OF THE SAME PLACE, WHO WERE MARRIED ON MONDAY THE TWENTY-SECOND DAY OF JANUARY, ONE THOUSAND EIGHT HUNDRED AND FORTY-FOUR BY LICENSE FROM I. M. HIGGINSON, ESQ., DEPUTY GOVERNOR.

BY ME

GEORGE O'NEILL STUART
RECTOR OF ST GEORGE'S
CHURCH, KINGSTON.

for on October 10th, 1844, Younghusband wrote to Lieut. Col. Maclachlan at Kingston:

Sir

I have the honor to enclose a copy of the marriage certificate of Gunner and Driver Thomas Menzies.

Gunner Menzies having made me acquainted with the circumstances, and his general character being very good, I have regarded him as married *with Leave. . . .*"

As Menzies' connection with the Toronto Observatory was long and honourable, this is the proper point at which to indicate a happy ending to his story.

On June 8, 1844, Younghusband sent the following statement about the instruments in the observatory to Colonel Sabine.

Toronto Canada
June 8, 1844.

My dear Col. Sabine,

I have received your letters of the 3d, 17th and 18th May.

I have adjusted the springs of the pressure plate of the Anemometer so that the instrument is as sensible as the construction of it will allow, and retaining a sufficient degree of power, that the greatest probable pressures may be recorded. The least pressure that can be recorded with the instrument is that of 1 lb. Anything above 1 lb. is clearly and satisfactorily shewn.

The observers are accustomed to enter the force of the wind in the Register from the Records of the Anemometer. Where the latter does not shew it, that is, when the pressure does not equal 1 lb., fractional parts of a pound are inserted by estimation.

I will send you a month's observations of the force of the wind, in two different forms: one, as shewn by the anemometer, and the other according to the estimated scale I sent home before.

The latter was not estimated as I now see it should have been done. The high pressures were taken from the anemometer, and the estimated expressions divided as nearly as possible.

You appear to be in some error with regard to the hygrometer. The dew point and elasticity of vapour are calculated entirely from the difference between the wet and dry Thermometers, according to Dr. Apjohn's formula. The last date on which the hygrometer was observed here, was 23rd October, 1840. A new one was received here in October, 1843, but it is not available for general purposes, the scale not being continued lower than 20°.

As I cannot detain this letter I must wait for the next mail to forward the Abstracts of the values of "g", etc., you ask for.

Believe me, etc.

C. W. Y.

And on November 26, 1844, Younghusband announced "that Lieut. Lefroy and Corporal Henry, Royal Artillery, arrived in Toronto on the 18th instant" and shortly after Lefroy took personal charge.

We have noticed above[40] that Lefroy showed signs of slight disappointment in Colonel Sabine's lack of appreciation of his work. Younghusband, however, had no reason to feel his work was not recognized. For in the *Introduction* to the *Observations Made at the Magnetical and Meteorological Observatory at Toronto in Canada* (London, 1845) Colonel Sabine gives a pointed summary of the work of these two men and their share in the credit due for the results of volume one in this publication:

> "Lieut. Lefroy did not arrive at Toronto until [October 23] 1842, and quitted it again in April 1843, to join the brigade of canoes proceeding from Lachine to the Hudson's Bay territories, from whence he returned in the autumn of 1844. Lieut. Younghusband has, therefore, been effectively the director of the Toronto Observatory from the commencement of 1841 tonearly the end of 1844, with the exception of the six winter months of 1842-1843. The Observations contained in this Volume afford the best testimony to the practical merits of the system established at the Toronto Observatory by Lieut. Riddell, and to the intelligence and steady perseverance with which it has been maintained by Lieut. Younghusband."[41]

When Riddell returned to England, he became Assistant Superintendent of Magnetic Observatories under Sabine in Woolwich; when Younghusband returned, he succeeded Riddell, who resigned that office.[42]

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[40]See Reference 13, above; also pp. 10-11.

[41]SABINE, EDWARD. Observations made at the Magnetical and Meteorological observatory at Toronto in Canada. London, 1845. Vol. 1, p. 19.

[42]LEFROY, J. H. Autobiography . . . p. 114.

(*To be Continued*)

ROBERT HENLEY COMBS

By E. J. A. Kennedy

THE death of Robert H. Combs on April 25, 1941, ended a most useful and colourful career. An electrical engineer by profession, he combined in an unusual degree the pioneer spirit with that of the scientific. Being intensely practical and possessed of boundless energy, his extensive knowledge in many fields was gained not only by study, but by actual experience.

He was borne in 1876, in the town of Springfield, Missouri, where he attended primary and high schools, later graduating from the Jesuit College in St. Louis, Missouri. He held no university degree. His father was a commercial traveller, and his mother, a quite remarkable woman, belonged to the English family of Henleys, whose birthplace was Henley on the Thames, and after which the great rowing regatta derives its name. In this connection, it is interesting to note that R. H. Combs held the position of Commodore of the Mississippi Power Boat Association. He skippered and was owner of the fastest motor-boat of its kind in 1909.

Early in life he joined the old St. Louis *Star*, and held the position of staff photographer—the first man, it is said, to hold such a position. Leaving the *Star* he followed the engineering profession, both electrical and mechanical, during his lifetime. In 1910 he joined the Presto-Lite organization, and in 1917 was sent to manage their Canadian business, known then as the Canadian National Carbon Co. Later the business was merged with another in the same field, and he was made president of the Presto-Lite Co. of Canada which position he held until his death. He was a member of the American Institute of Electrical Engineers, also of the Association of Professional Engineers of Ontario.

In radio broadcasting, Mr. Combs played a very important part. In 1904, he became associated with Lee De Forest, and together they arranged radio contact between the Louisiana Purchase Exposition, and the St. Louis *Star*. After coming to Canada, he continued his experiments in radio and established one of the first broadcasting stations at his home in Lauder Ave. This was in 1924, and of the

early stations, his is the only one that has continued until now. His call letters were CHNC. This station is now CBY. He was also responsible for organizing the Toronto Radio Research Society, and the founder of the Canadian section of Automotive Engineers.

As an amateur astronomer, he showed the same enthusiasm as in his other activities. He possessed two excellent reflecting telesopes—a ten-inch, which he housed in an observatory built at his summer home at Rice Lake, Ontario, and a four-inch portable. Combined with his observations through his telescope, he did some expert coloured motion photography—sunsets, cloud effects, etc.—and although an exceedingly busy man, he found time to share his pleasures by showing his films and pictures before many societies and schools. He was a member of the Toronto Centre of the Royal Astronomical Society of Canada, and held the position of Recording Secretary of the General Society.

Of his hobbies, much could be said. He was an authority on rare oriental rugs and possessed a very valuable collection. One unusual hobby was the collecting of semi-precious stones. His collection is conceded to be the finest in Canada. As a philatelist, he also excelled, especially in United States and British stamps. An ardent fisherman and sportsman, generally, the presence in his home of many trophies indicate his interest in sport.

Altogether, he lived a very full life, entering into his various activities with a remarkable enthusiasm, and the writer has heard many tributes of his great generosity in using his talents to give pleasure to others. He is missed greatly in his business organization, and the various scientific societies with whom he was associated will feel keenly the loss of a most active and useful member.

THE MOON AND THE WEATHER

From a Radio Talk by C. A. C.

FROM ancient times there has been a firm belief that the moon influences the weather, and it still persists to-day. If the ground is parched, a change in the moon will bring rain; or if there has been a period of wet weather the change in the moon—which is certain to come—will bring fair weather and clear skies. It is a comforting faith, but there seems to be little foundation for it.

Is there any reason to expect the moon to affect the weather?

It is common knowledge that the sun and moon, chiefly the latter, cause the tides of the ocean. Now our atmosphere, enveloping the earth, is subject to the attractions of the same bodies, which therefore should produce tides in it. Further, our weather is due to changes in the atmosphere, and the question arises, Do the atmospheric tides affect the weather?

After tedious analysis of barometric pressures extending over many years, clear evidence has been obtained of tides in the atmosphere. It is heaped up at some places and taken away from others—high tide and low tide. But the effect is very slight. At Toronto the addition to the normal pressure due to the atmospheric tide is about one ten-thousandth of an inch of mercury, and this is the greatest at any station in Canada; at Vancouver the amount is one-sixteenth as great. These changes in the barometric pressure due to atmospheric tides are less than one-hundredth part of the changes due to other causes. Their action on weather conditions is entirely negligible. They are not considered in forecasting.

In the year 7937 there was published an elaborate memoir on the influence of the moon on the weather by Father Luis Rodès, the director of the Observatory of the Ebro which is located near Tortosa in Spain. In its neighbourhood there was much fighting during the recent unhappy contest in Spain and the observatory was for some time disorganized. It was established in 1904 to study the influence of solar activity upon our planet. Since 1910 a complete record of the condition of the sun and the temperature, pressure, humidity, and the electrical and magnetic conditions at Tortosa have been kept.

After a thorough examination of his twenty years of records Father Rodès states that there seems to be a slight excess of rain when the moon is nearest the earth (at perigee) over that when farthest away (at apogee); but no influence of change of phase on the weather could be detected; also, there was no confirmation that any changes during the moon's revolution were associated with changes in the weather.

Sunrise from an Aeroplane

In *Harper's Magazine* a pilot who was flying a Hudson Bomber to England gives the following description of a sunrise. The trip was made in 8 hours 56 minutes.

The moon is down now and grayness gradually gives way to a pink morning glow.

"Gosh, that's beautiful", Ben remarks.

Now we seem to be looking at a mill furnace from behind a heavy glass screen. A steel ball is being heated by raging red-orange fires; the ball is a different shade of red. As the heat mounts, the screen becomes more and more transparent and the ball assumes a pinkish hue. Then it comes to a white heat and the fires beneath it fade out as if their job was finished. This is the airman's sunrise.

C. A. C.

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

Mount Wilson Observatory, Report for 1940

In the last Annual Report of the Director of the Mount Wilson Observatory, issued December, 1940, there is a brief account of the numerous and diversified researches carried on at that famous place. It is so condensed that understandable quotations can hardly be made, but from the summary at the beginning the following paragraphs giving results of very general interest are taken.

Nature of the Moon's Surface

Our knowledge of the materials constituting the visible surface of the moon has been notably increased during recent years, mainly through the work of F. E. Wright, of the Geophysical Laboratory. During his visits to Mount Wilson he has skilfully applied several methods of approach to this problem, especially through measures of the polarization of the reflected light. Recent observations of a total lunar eclipse agree in indicating that the drop in temperature as the earth's shadow passes across the moon's disc is such as would be expected from a surface covered with a thin layer of fine dust or ash. During totality the temperature dropped from 370°C absolute to 175°.

Water Vapour on Mars

Planetary observations have been limited to determinations of position of the fainter satellites of Jupiter, including the two discovered by Nicholson about two years ago, and to some spectroscopic observations of Mars. The amount of water vapour above the equatorial areas of Mars is found to be definitely less than 5 per cent. of that in the earth's atmosphere.

Interesting Galactic Nebulae

Two nebulae within our galaxy have been investigated for expanding motion, and the distance of one of these, the well-known filamentary nebula in Cygnus, has been found to be less than 1000 light-years. Some interesting photographs of galactic nebulae showing unusual detail have been made with red-sensitive plates and Kodachrome films.

Enormous Velocity of an Extra-galactic Nebula

In the wide field of study of the extra-galactic nebulae, emphasis has gradually been shifting from general surveys to specific problems. This has been particularly true in nebular spectroscopy, where gains in instrumental light-efficiency have made it possible to use higher dispersion than heretofore on important

individual nebulae. One valuable result is the establishment with higher accuracy of an extreme point on the velocity-distance curve, a nebula in Boötes showing a red shift corresponding to a radial velocity of recession of 39,000 km. per sec. The rotation of one nebula has been studied in detail with the spectrograph, and from among the 1000 brightest nebulae in the northern sky three others have been selected for observation which should yield an answer to the interesting question of the direction of rotation. A program is also being devised for more accurate determinations of the radial velocities of the components of double nebulae, data which would yield values of nebular masses. Existing results suggest an upper limit of mass of the order of 10^{10} suns.

Mathematics in King Charles II's Time

In Pepys's *Diary* are remarks on all sorts of matters and it is interesting to read the author's references to mathematics and other branches of science. Herewith are three:

1662, July 4.—By and by comes Mr. Cooper, mate of the Royall Charles, of whom I intend to learn mathematics, and do begin with him to-day, he being a very able man. . . . After an hour's being with him at arithmetique (my first attempt being to learn the multiplication table); then we parted till to-morrow.

July 9.—Up by four o'clock, and at my multiplicacion table hard.

1663, November 6.—. . . among other things heard Sir John Cutler say, that of his owne experience in time of thunder, so many barrels of beer as have a piece of iron laid upon them will not be soured, and the others will.

It is evident that the attainments in mathematics of the people in general were decidedly low. However, with the growing neglect of arithmetic in our common schools and with the increasing use of cash registers and calculating machines, the time may come again when the multiplication table will be beyond the attainments of the ordinary citizen.

Pepys obtained the B.A. degree at Cambridge in 1654 and the M.A. in 1660. In 1665 he became a Fellow of the Royal Society, which was founded a few years earlier, and he was President of the Society in 1685 and 1686. During his tenure of office it fell to him to license the printing of Newton's *Principia*. On its title page appears, "Imprimatur. S. Pepys, Reg. Soc. Præses, Julii 5, 1686." The ordinary level of mathematical knowledge may have been low, but there were mighty mountains of mathematical genius with their summits in the clouds.

A New Iron Meteorite

The finding of a great iron meteorite weighing nearly a ton is reported by *Science Service*. When ploughing in a Georgia cotton-field the plough struck some hard object and as the red soil in that particular part of the state is almost entirely free from rocks, the ploughboy's curiosity led him to dig down to see what the obstruction was. It was almost two feet below the surface. He managed to break off a piece, which showed it to be an iron meteorite. The object has been taken to the Smithsonian Institution for study and display in the U.S. National Museum. It is the second largest body of its kind ever found east of the Mississippi River. The precise place of the discovery is not given.

Four Calendars in Egypt

Egypt had four calendars, which certainly in the XIIth dynasty were all observed, as four different new-year festivals are stated as times for offerings. This is by no means incredible, as Egypt now keeps, (1) a lunar (Muslim) calendar in official use, (2) a fixed seasonal calendar in agricultural use, (3) a true calendar in European use, and (4) a Greek calendar in religious use.—Petrie, *Wisdom of the Egyptians*, p. 4 (1940). C. A. C.

Personal Note

Dr. Daniel Buchanan, Dean of the Faculty of Arts and Science and Head of the Department of Mathematics of the University of British Columbia, will be a member of the faculty of the summer session of the University of California at Los Angeles, June 30 to August 8, as visiting professor of astronomy and mathematics; while Dr. Frederick C. Leonard, Chairman of the Department of Astronomy of the University of California at Los Angeles, will serve as visiting professor of astronomy in the summer session of the University of British Columbia, Vancouver, B.C., July 7 to August 22, 1941. This will be the third time that Dean Buchanan has gone to the University of California at Los Angeles and Professor Leonard has come to the University of British Columbia for the period of the summer session, a similar exchange having been made by them in 1937 and in 1939. J. A. P.

MEETINGS OF THE SOCIETY

AT WINNIPEG

April 9, 1941.—The regular meeting of the Winnipeg Centre was held in the University of Manitoba. Mr. L. W. Koser, president, was in the chair. This was the annual Members' Night, and four members took part.

The first speaker, whose topic was "Astronomical Observation from the Standpoint of the Amateur," was Mr. R. S. Evans. With very excellent slides he explained the essentials of knowledge necessary before observations can be appreciated.

Mr. L. J. Crocker followed with a short history of meteorology from the time of Aristotle up to the present. Some of the early information was most astonishing in the light of present knowledge. The discovery of laws and the establishment of weather stations were fully noted.

Mr. W. P. Johnson next expertly explained, with diagrams, the instruments in use at air field weather stations to-day. These instruments include the barograph, thermograph, sun dial, anemometer, transit and hydrogen balloon and the alidade.

In conclusion, Mr. H. E. Riter distributed weather maps and, after explaining the cause of westerly winds with their arctic and torrid fronts, applied the information given by Mr. Johnston regarding instruments to make these maps clearly understood.

OLIVE A. ARMSTRONG.

May 14, 1941.—The last meeting of the season was held in Theatre "F" of the University of Manitoba. The President, Mr. L. W. Koser, was in the chair.

The lecture was given by the honorary president, Mons. T. W. Morton, who chose "Transmission of Energy," for his subject.

Beginning with general statements about energy, he described and illustrated the motions of translation, rotation and vibration.

Then, in detail, he discussed the laws of vibration as illustrated by Galileo's pendulum. These cause pitch, amplitude and overtones of sound. The diatonic scale was fully explained.

The climax of the lecture was reached when the compound motions of the harmonics were demonstrated with the use of a pendulum whose "bob" was a perforated can containing sand. As the pendulum lengths were varied the complicated vibrations were clearly illustrated by patterns of sand upon the floor.

Following the lecture lengthy discussions testified to the interest and respect of the audience for their beloved honorary president.

OLIVE A. ARMSTRONG.

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R. K. YOUNG,
Director, David Dunlap Observatory

Richmond Hill, Ont.